FORM PTO-1390 (REV. 11-2000) — US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
P/61767-PCT	09/914936

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/GB00/00809	March 6, 2000	March 5, 1999

TITLE OF INVENTION **CHEMICAL SENSOR SYSTEMS**

APPLICANT(S) FOR DO/EO/US **Andrew PIKE**

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to begin national examination procedures (35 U.S.C. 371 (f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [ ] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is attached hereto (required only if not communicated by the International Bureau).
   b. [X] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. [ ] is attached hereto.
   b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [X] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [ ] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [ ] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. [X] Other items or information: **Receipt Acknowledgement Postcard**

04 SEP 2001

U.S. APPLICATION NO (If Known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/914936	PCT/GB00/00809	P/62767-PCT

21. [X] The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1,000.00	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	$860.00	
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$710.00	
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$690.00	
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00	

ENTER APPROPRIATE BASIC FEE AMOUNT =				$860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				$0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	24 - 20 =	4	x **$18.00**	$72.00	
Independent claims	1 - 3 =	0	x **$80.00**	$0.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$270.00**	$0.00	
TOTAL OF ABOVE CALCULATIONS =				$932.00	
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				$0.00	
SUBTOTAL =				$932.00	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$0.00	
TOTAL NATIONAL FEE =				$932.00	
Fee for recording the enclosed assignment (37 CFR 1.21 (h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$0.00	
TOTAL FEES ENCLOSED =				$932.00	
				Amount to be refunded:	$
				charged:	$

a. [X] A check in the amount of **$932.00** to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-1145. A duplicate copy of this sheet is enclosed.

I hereby certify that this correspondence is being deposited with the United States Postal Service asExpress Mail No. EL 337 911 286 US in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on:

September 4, 2001 (date) — Alan Israel / Reg. No. 27,564

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Alan ISRAEL, Esq.
KIRSCHSTEIN, OTTINGER, ISRAEL & SCHIFFMILLER, P.C.
489 Fifth Avenue
New York, New York 10017
212/697-3750

SIGNATURE:

Alan Israel
NAME

27,564
REGISTRATION NUMBER

Docket No.: P/61767

PATENTS
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as Express Mail No. EL 337 911 286 US in an envelope addressed to: Box: PCT, Commissioner of Patents and Trademarks, Washington, D.C , 20231, on:
September 4, 2001
(date)
Alan Israel
Reg. No. 27,564

International Application No.: PCT/GB00/00809

International Filing Date : March 6, 2000

In re: Application of : Andrew PIKE

Deposited : September 4, 2001

For : CHEMICAL SENSOR SYSTEMS

New York, New York
September 4, 2001

PRELIMINARY AMENDMENT

BOX: PCT
Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Prior to calculation of the filing fee and before examination, kindly amend the above captioned application as follows:

IN THE CLAIMS:

Please cancel claims 1-26, without prejudice.

Please add the new set of claims set forth on the enclosed pages.

IN THE ABSTRACT:

Delete the "Abstract"on the PCT cover sheet and replace it with the "Abstract of the Disclosure" set forth on a separate sheet attached hereto.

REMARKS

An abstract has been provided on a separate sheet; and the claims have been amended to conform to U.S. practice.

Wherefore, an early action on the merits is earnestly solicited.

Respectfully submitted,

KIRSCHSTEIN, OTTINGER, ISRAEL & SCHIFFMILLER, P.C.
Attorneys for Applicant(s)
489 Fifth Avenue
New York, New York 10017-6105
Tel: (212) 697-3750
Fax: (212) 949-1690

Alan Israel
Registration No. 27,564

ABSTRACT OF THE DISCLOSURE

In a chemical sensor system, samples are taken at multiple locations and then processed at a single processor module to give at or on line monitoring of a product or process.

PROPOSED NEW CLAIMS

27. A chemical sensor system for at - or on - line monitoring of a product or process, comprising:

a) sampling means for acquiring samples of at least one substance to be sensed from a plurality of different locations in the product or process line;

b) sensor means including an array of sensors for sensing the samples; and

c) processing means for deriving information from an output of the sensor means concerning said at least one substance.

28. The system as claimed in claim 27, wherein the locations at which the samples are taken are remote from one another.

29. The system as claimed in claim 27, wherein the locations at which the samples are taken are local to one another.

30. The system as claimed in claim 27, wherein the sensor means comprises a plurality of sensor arrays located at respective different locations.

31. The system as claimed in claim 30, wherein the sensor arrays are housed in separate modules.

32. The system as claimed in claim 27, wherein the sampling means and the sensor means are housed in a common module.

33. The system as claimed in claim 27, wherein the processing means is operative for acquiring simultaneously information relating to the samples acquired from the respective different locations.

34. The system as claimed in claim 27, wherein the processing means is operative for applying pattern recognition to data relating to the samples.

35. The system as claimed in claim 27, and further comprising a user interface.

36. The system as claimed in claim 27, and further comprising means for deriving signals to control the product or process line in dependence on the samples acquired.

37. The system as claimed in claim 27, and further comprising means for controlling at least one of the sampling means and the sensor means in dependence on information derived from the samples acquired.

38. The system as claimed in claim 27, wherein the processing means is operative for providing control signals to the sensor means.

39. The system as claimed in claim 27, wherein the sensor means comprises at least one sensor array module having sample handling capability.

40. The system as claimed in claim 27, wherein the sensor means includes at least one of the following types of sensor technology: mass sensitive sensors; electronic conductance or capacitance sensors; field effect sensors; calorimetric sensors; electrochemical sensors; optochemical or photometric sensors; and biosensors.

41. The system as claimed in claim 40, wherein the sensor means includes sensors of only one sensor technology type.

42. The system as claimed in claim 40, wherein the sensor means includes sensors of a combination of different technology types.

43. The system as claimed in claim 27, wherein the sampling means uses at least one of the following techniques to acquire the samples: portable; liquid headspace; liquid sparge;

sample vaporization; a probe; solid head space; direct insertion of an array of liquid phase chemical sensors into the sample or sample stream; gas line and ambient monitoring.

44. The system as claimed in claim 27, and further comprising a bus connecting a plurality of sensor arrays to the processing means.

45. The system as claimed in claim 27, wherein the processing means is connected to the sensor means via an asynchronous multi-drop serial data link.

46. The system as claimed in claim 27, wherein the processing means is arranged to poll, in turn, sensor arrays included in the sensor means.

47. The system as claimed in claim 27, wherein the processing means includes a single board computer, a hard drive, and a user interface display.

48. The system as claimed in claim 27, and further comprising a relative humidity sensor.

49. The system as claimed in claim 46, wherein data transmitted from each sensor array includes an identification number identifying the respective array.

50. The system as claimed in claim 27, in which samples of effluent from a chemical processing plant are monitored at the different locations.

2/prts 1

Chemical Sensor Systems

This invention relates to chemical sensor systems, and more particularly for at- or on-line monitoring of a product or process.

Chemical sensor array systems for sensing in the liquid, gas or vapour phase, including as a sub-class those arrays sometimes referred to as electronic noses as they operate using odour analysis, have been successfully employed in laboratory instruments for the measurement of headspace volatiles. Typical applications include quality control of raw materials and final product, new product development and correlation with sensory panel data. Those instruments developed to date have primarily aimed at laboratory use.

In applications where substances are being handled or modified during manufacture or processing, there are typically several stages during the process where there is a requirement for assessment of quality, authenticity and/or compositional property of a substance. Chemical sensor array systems (SAT) may be used in assessing these characteristics.

The present invention seeks to provide a chemical sensor system which is particularly suitable for at-line or on-line monitoring.

According to the invention, there is provided a chemical sensor system for at or on-line monitoring of a product or process comprising: sampling means arranged to acquire samples of a substance to be sensed from a plurality of different locations in the product or process line; sensor means including an array of sensors arranged to sense the samples; and

processing means for deriving information from the output of the sensor means concerning the substance or substances to be sensed.

As used in this specification, "at-line" means that a monitoring instrument is located next to the detection point of interest, from which a sample may be introduced either manually or by automated means. Analysis of the product or process is achieved from a discrete sample or batched samples. The term "on-line" is defined to mean that there is a physical connection between the monitoring system and the detection point, which allows the product or process to be monitored by discrete samples, batched samples or continuously with automated sampling. "In-line" systems are a subset of on-line systems.

By using the invention, it is possible to analyse samples of substances from different locations in a product or process line and to assess them together within the process system as a whole or to assess samples individually. This would, for instance, provide a means of monitoring at several stages during a production process. The substance sampled at a plurality of different locations may be nominally the same substance or it could be another substance introduced, modified or generated during a production process. More than one substance may be sensed at a single location to give a more complete characterisation of the manufacturing or process line.

The advantage of using monitoring technology in an at-line or on-line configuration is that it enables 'point of use' or in-situ measurement of a sample which in turn allows real-time monitoring of a product or process. A process to be monitored may involve one or more physical or chemical procedures used in the treatment, conversion or manufacture of an

intermediate or final product. In a manufacturing environment at- or in-line monitoring allows rapid corrective action to be taken if there has been a deviation from normal or acceptable performance or quality in product or process. The delay in taking a sample for remote off-line analysis in a laboratory-based instrument is often unacceptable. At and on-line monitoring is therefore preferable in many areas of industry and also in environments where the system is monitoring for hazardous conditions e.g. fire or generation of toxic vapours.

The sampling means may be incorporated as part of the sensor means, with sensors of the sensor means being placed at a detection point of interest. The sampling means might alternatively be discrete from the sensor means. Examples of the sample means are arrangements using at least one of the following techniques to acquire a sample: portable; liquid headspace; liquid sparge; sample vaporisation; a probe; solid head space; direct insertion of an array of liquid phase chemical sensors into the sample or sample stream; gas line and ambient monitoring. For a particular system, it is necessary to select a sample handling technique appropriate to the substance to sensed.

A sample handling apparatus extracting a sample from a liquid head space is suitable for monitoring ambient volatiles above a liquid sample. Liquid sparge comprises flushing a liquid sample with inert gas to release volatiles. A probe may comprise, for example, a flexible tube and pump to acquire a sample. In a solid head space, ambient volatiles are monitored above a solid sample. A gas line might be used in which a sample is drawn off from a gas stream, this being particularly suitable for processes involving fermentation. A sample handling module may use an ambient technique such as passive monitoring of the

local environment, for example, for fire detection. Other techniques may be appropriate for other applications. Where a sample is to be monitored in the liquid phase a sensor array may be inserted into the sample or sample stream.

The sample handling means may be such as to acquire a sample without operator intervention to give an automated procedure, and samples may be taken at discrete time intervals which are fixed or variable, or continuously. Also, switching between discrete, batched and continuous sampling may take place depending on the particular time in a production process, location from which the sample is taken or for some other reason.

In one system, the sampling apparatus includes means to introduce a calibration or reference sample. Alternatively, this may be provided at the sensor means. This allows calibration or checking of the sensor array performance.

The distributed chemical sensor system may provide information concerning the operation of a production line or a process which can then be used in a control feedback system, in which data generated by the system is fed back to determine the settings of control hardware, for example, in a System Control and Data Acquisition (SCADA) system. Feedback may also be provided to the monitoring system itself, for example, to adjust sensor settings or sampling frequency.

In one embodiment of the invention, the sensor means comprises a plurality of sensor arrays located at respective different locations. This minimizes the path to be taken between the sampling means and sensor means, where these are separately housed, as each sensor

array module may be located at the detection point at which the sample is acquired.

In a chemical sensor, a change in a physical property, such as a change in electrical conductivity, is produced in response to a gas or vapour being sensed. Many different sensor technologies are available for use in the sensor means. Advantageously, the sensor means includes a sensor array using at least one of the following types of sensor technology: mass sensitive sensor; electronic conductance or capacitance sensors; field effect sensors; calorimetric sensors; electrochemical sensors (for example, amperometric, potentiometric or conductimetric sensors); optochemical or photometric sensors; and biosensors. In fact any sensor which produces a useful output corresponding to a change in characteristic when a chemical is sensed may be suitable. Mass sensitive sensors may be for example those using bulk acoustic wave or surface acoustic wave techniques. Electronic conductance and capacitance sensors may be for example chemo-resistors based on conducting polymer or metal oxide semiconductor materials. Calorimetric sensors may for example be pellistors. Electrochemical sensors are for example potentiometric cells. Infra red and fibre optic based techniques may be used in optochemical or photometric sensors. Biosensor and electrochemical sensors may be particularly suitable for liquid phase sensing.

A system in accordance with the invention may include a sensor array having sensors of one technology type only. In that case, the sensor environment can be specifically tailored for use with sensors of that type. In alternative arrangements, the sensor array includes sensors of a combination of different technology types. This gives increased sensitivity and/or discrimination in some cases, the particular combination being tailored to the substance to be sensed. Several sensor arrays of differing technology types or different

combinations of technology types may be included in a system.

The processing means may be arranged to simultaneously accept information relating to samples acquired from respective different locations or to obtain such information sequentially. The information obtained from the samples taken at different points may individually be used to give an assessment of the state of the product or process on-line or they may be used in combination. Thus, the processing means may classify substances at individual locations or classify the status of the line as a whole.

Preferably, the processing means uses pattern recognition to characterise the substance. The pattern recognition technique used in the processing module may use at least one of the following: a statistical method (for example; principal component analysis (PCA), or multiple discriminant analysis (MDA)); fuzzy logic; an artificial neural network; and a proprietary classifier algorithm. The technique or techniques adopted depend on the substance to be sensed and the use made by the system of information acquired via the monitoring procedure.

Some ways in which the invention may be performed are now described by way of example with reference to the accompany drawings in which:

Figure 1 schematically illustrates a chemical sensor system in accordance with the present invention; and

Figures 2, 3 and 4 relate to another chemical sensor system in accordance with the invention.

With reference to Figure 1, a chemical sensor array system is used to monitor a product manufactured by a process including several processing steps. In this case it is wished to monitor the composition of a substance at various points in the processing method to assess the effectiveness of the process line. The monitoring system includes a sampler 1 at a first point A at which a sample of the substance is extracted using an appropriate sampling technique. In this case, a sample is taken at fixed timing intervals. The container in which the sample is housed is connected via a pipe to a sensor array module 2 in such a way that volatiles existing in the headspace above the solid sample are transferred over sensors of the array. The output of the sensors is determined by their response to the volatiles to which they are exposed. In this case, the sensor array module 2 combines a plurality of different sensor technologies providing a set of signal outputs characteristic of the substance of the sample. A central processor 3 accesses the outputs of the sensor array module 2 via a fixed link 4 to provide a series of data points characteristic of the sample being sent. Pre-processing occurs in the central processor 3 to place the acquired data in a form suitable for pattern recognition techniques to be applied thereto.

A second sampler 5 is arranged to take samples downstream of location A at a second location B at which stage it is expected that the substance being processed has been modified. A sample is taken by the sample handling means 5 in a way appropriate to the form of the substance and the most appropriate types of sensor technology to detect changes in its physical or chemical characteristics. The sample is presented to a second sensor array module

6 which is located locally to the sample handling means 5. The second sensor array module 6 produces a set of responses characteristic of the composition of the substance being sampled. These are also accessed by the central processor 3. Additional samples may be taken at other points of detection in the process line. These points of detection may be down-stream of the first one or could be at locations A and B but arranged to take samples of different substances.

The central processor 3 is arranged to apply a suitable pattern recognition technique to the data required from the second sensor array module 6. The processor 3 then assesses the data derived from each sensor array module in turn to characterise the substance sampled at the point of detection associated with that sensor array module. In addition, the central processor 3 provides an overview of the production line as a whole to characterise the entire process system.

The information which results from the processing stage is then applied by a link 7 to a user interface 8, which in this case takes the form of a visual display from which an operator may view the performance of the system. In addition, the user interface 8 permits the operator to input control data, for example, to vary the frequency at which samples are taken, control characteristics of sensors in the sensor array modules 2 or 6 or to implement different functions of the central processor 3. Other changes to the monitoring system may be arranged to be implemented or automatically via the central processor 3. For example, if the central processor 3 detects rapid changes in characteristics of a set of samples, it may send control signals to the sample means to increase the rate at which samples are taken.

The central processor 3 is also linked via line 9 to a manufacture control system 10 which utilises the information acquired from the monitoring system to adjust the parameters of the process line in dependence on any detected variations from the sample composition from the desired characteristics.

The central processor 3 may be set up so that it is able to acquire data communicated from either a single sensor array module or from several and place them into a form which is suitable for further processing. A pattern recognition technique may be applied to each sensor array module in turn or to a plurality of sensor array modules simultaneously.

Another system in accordance with the invention is illustrated in Figure 2. This system is used in the monitoring of waste water from a chemical plant. Samples are taken at three locations XA, XB and XC via samplers 11, 12 and 13 each of which is associated with its own sensor module 14, 15 and 16. The outputs of the sensor modules 14, 15 and 16 are connected via a bus arrangement 17 to a processing module 18. A user interface 19 is integrated into the same enclosure 20 as the processing module 18. A schematic diagram of the enclosure 20 is illustrated in Figure 3.

The processor elements of the module 18 comprise a single board computer (SBC) 21 and a hard-drive 22 to provide additional memory. The user interface includes a flat panel display 23 and a keypad 24 that are mounted on the front of the enclosure 20. The software to acquire and control the system is run on a DOS operating system installed on the Single Board Computer 21. The setup and operation of the system is menu driven via the software, visible on the display 23. Buttons on the keypad 24 are used to select menu items. The SBC

21 is connected to sensor modules 14, 15 and 16 via an asynchronous RS 485 multi-drop serial data link. A power supply unit (psu) 25 is also included in enclosure 20.

One of the sensor modules 14 is illustrated in Figure 4 and includes means for transmitting and receiving data and control signals from the processor module 18. It contains an array 26 of chemical sensors which is in a temperature controlled housing 27 that allows samples to pass over the sensors. In some sensor modules the flow and relative humidity (RH) are also measured. Other parameters relating to sensor operation are also controlled. All the sensor and control hardware 30 require interface electronics 28 to make them compatible with the input/outputs of a microcomputer 29. The microcomputer 29 acquires sensor data and transmits the data over the RS 485 connection to the processor 18 via a driver IC 31. The RS 485 driver IC 31 is required to interface the signals over the data communications bus 17 to the microcomputer 29 . Data is collected, processed and transmitted to the processor module 18. The other sensor modules 15 and 16 are similarly configured.

Both the microcomputer 29 in the sensor module 14 and the SBC 21 in the processor 18 adhere to the same interface protocol. In this instance, the data link is 19,200 baud, and the data mode is 8 data bits, 1 stop bit, even parity. This can be reconfigured for different applications.

The SBC 21 will communicate with a sensor module 14, 15 or 16 via a number of commands e.g. idle mode, acquire data, cleanup mode, diagnostics. Other commands relating to changing the setup of the sensor module may also be sent. A sensor module may send a reply to the SBC 21 to inform that the message has been received and understood. Each sensor

module has a unique identifying number that is used by the SBC to identify the recipient of a command. Since the RS 485 bus is multi-drop, a number of units can be connected to the same pair of wires. Normally, communication will be with one sensor module at a time, but certain commands can be sent to all sensor modules at once by use of a global identifier. When data is transmitted from the sensor module to the SBC, data relating to the identity of the sensor module is attached. In one mode of operation each sensor module is polled in turn by the processor module to avoid message collision.

An application that can benefit from this invention is a process plant that has its effluent monitored in order that its chemical composition does not exceed levels set by environmental agencies. At these sites there are typically multiple sources of effluent, which are connected together to form a single drain off site. A sensor module can be installed at each of the sources of effluent using a suitable sampling technique. By collecting the entire chemical sensor data at the processor unit across the data link, it provides a profile of the quality of effluent water across the whole site. This information can be used to control the diversion of polluted water into temporary storage to prevent chemical content levels being exceeded off the site.

Other applications include processes where batches are blended to attain a final product of uniform quality.

CLAIMS

1. A chemical sensor system for at- or on-line monitoring of a product or process comprising: sampling means arranged to acquire samples of at least one substance to be sensed from a plurality of different locations in the product or process line; sensor means including an array of sensors arranged to sense the samples; and processing means for deriving information from the output of the sensor means concerning the substance or substances to be sensed.

2. A system as claimed in claim 1 wherein locations at which the samples are taken are remote from one another.

3. A system as claimed in claim 1 or 2 wherein locations at which the samples are taken are local to one another.

4. A system as claimed in claim 1, 2 or 3 wherein the sensor means comprises a plurality of sensor arrays located at respective different locations.

5. A system as claimed in claim 4 wherein the sensor arrays are housed in separate modules.

6. A systems as claimed in any preceding claim wherein sampling means and sensor means are housed in a common module.

7. A system as claimed in any preceding claim wherein the processing means is arranged to

acquire simultaneously information relating to samples acquired from respective different locations.

8. A system as claimed in any of claims 1 to 6 wherein the processing means is arranged to acquire sequentially information relating to samples acquired from respective different locations.

9. A system as claimed in any preceding claim wherein processing means is arranged to apply pattern recognition to data relating to the samples.

10. A system as claimed in any preceding claim and including a user interface.

11. A system as claimed in any preceding claim and including means for deriving signals to control the product or process line in dependence on the samples sensed.

12. A system as claimed in any preceding claim and including means for controlling the sampling means and/or sensor means in dependence on information derived from the samples sensed.

13. A system as claimed in any preceding claim wherein the processing means provides control signals to the sensor means.

14. A system as claimed in any preceding claim wherein the sensor means comprises at least one sensor array module which includes sample handling capability.

15. A system as claimed in any preceding claim wherein the sensor means includes at least one of the following types of sensor technology: mass sensitive sensors; electronic conductance or capacitance sensors; field effect sensors; calorimetric sensors; electrochemical sensors; optochemical or photometric sensors; and biosensors.

16. A system as claimed in any preceding claim wherein the sensor means includes sensors of only one sensor technology type.

17. A system as claimed in any of claims 1 to 15 wherein the sensor means includes sensors of a combination of different technology types.

18. A system as claimed in any preceding claim wherein the sampling means uses at least one of the following techniques to acquire a sample: portable; liquid headspace; liquid sparge; sample vaporisation; a probe; solid head space; direct insertion of an array of liquid phase chemical sensors into the sample or sample stream; gas line and ambient monitoring.

19. A system as claimed in any preceding claim and including a bus connecting a plurality of sensor arrays to the processing means.

20. A system as claimed in any preceding claim wherein the processing means is connected to the sensor means via an asynchronous multi-drop serial data link.

21. A system as claimed in any preceding claim wherein the processing means is arranged to poll in turn sensor arrays included in the sensor means.

22. A system as claimed in any preceding claim wherein the processing means includes a single board computer, a hard drive and a user interface display.

23. A system as claimed in any preceding claim and including a relative humidity sensor.

24. A system as claimed in any preceding claim and wherein data transmitted from a sensor array includes an identification number identifying that array.

25. A system as claimed in any preceding claim in which samples of effluent from a chemical processing plant are monitored at different locations.

26. A chemical sensor system for at- or on-line monitoring of a product or process substantially as illustrated in and described with reference to the accompanying drawing.

09/914936

WO 00/54045

PCT/GB00/00809

Fig.1.

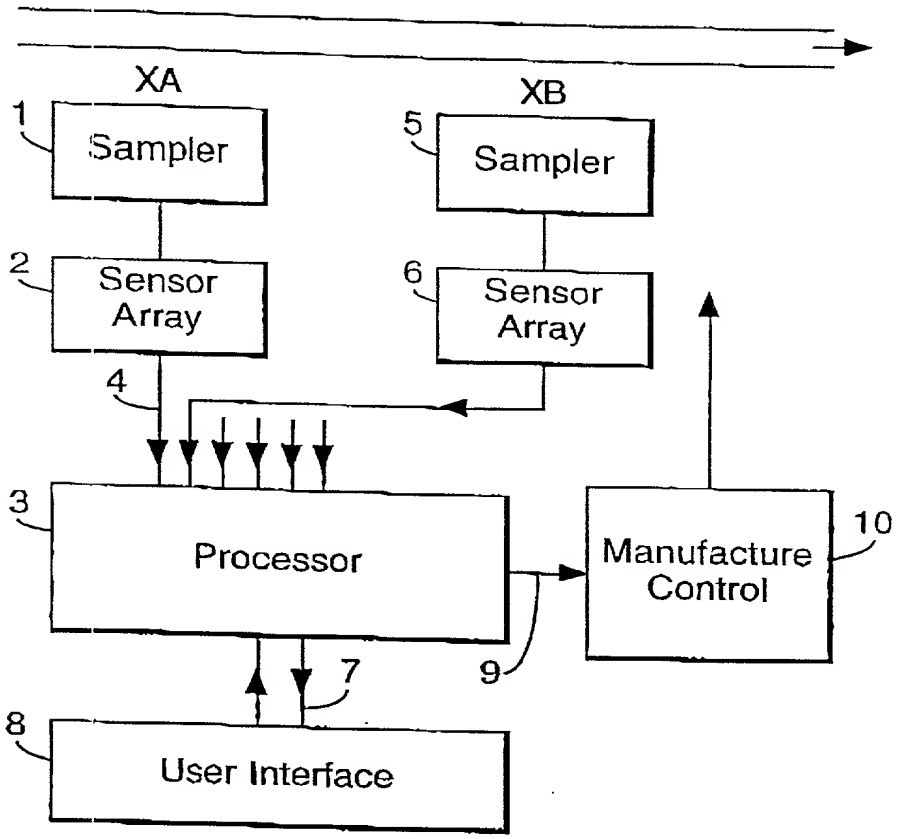


Fig.2.

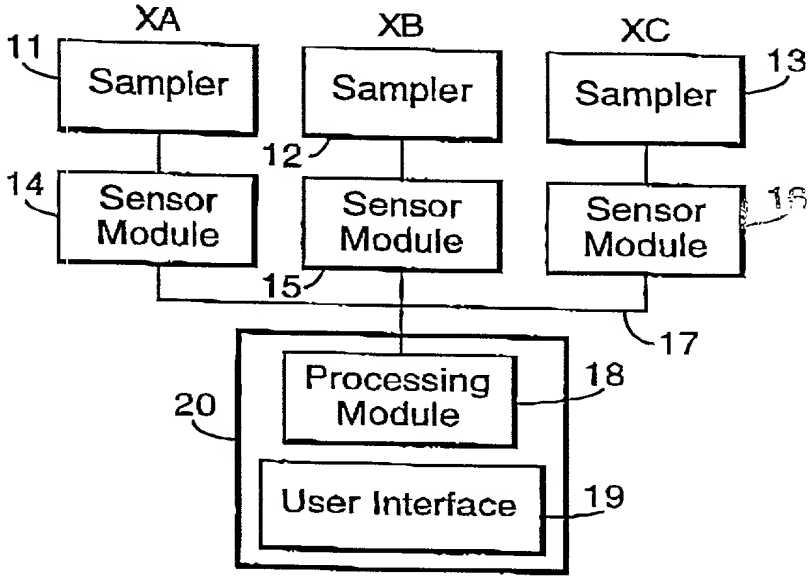


Fig.3.

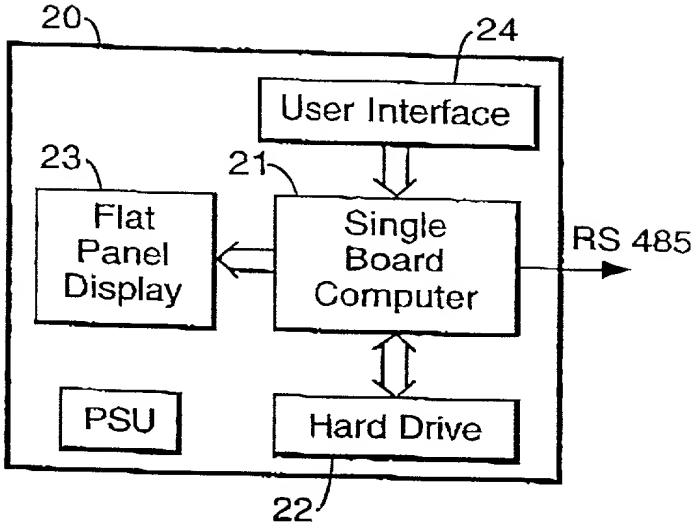
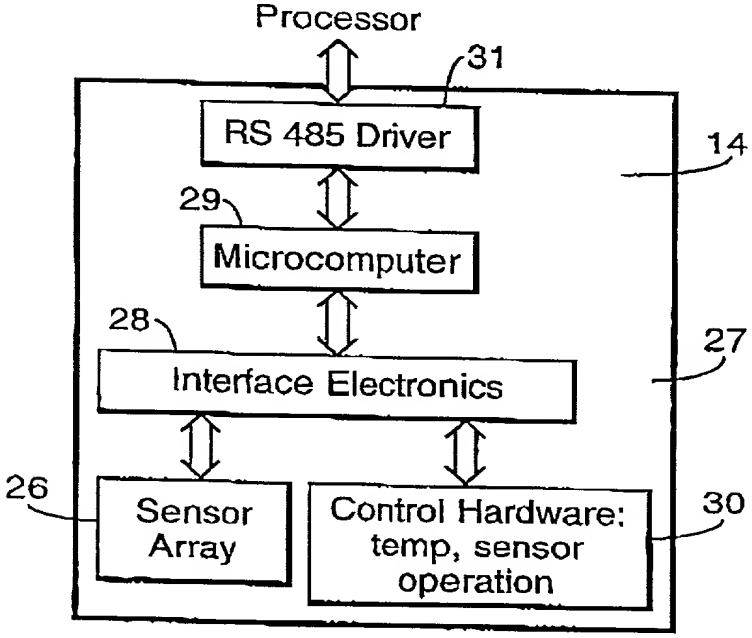

20
24
User Interface
23
21
Flat Panel Display
Single Board Computer
RS 485
PSU
Hard Drive
22

Fig.4.


Processor
31
RS 485 Driver
14
29
Microcomputer
28
27
Interface Electronics
26
Sensor Array
Control Hardware: temp, sensor operation
30

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PTO/SB/01 (6-95)
Approved for use through 9/30/98 OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION

☐ Declaration OR Submitted with Initial Filing

☒ Declaration Submitted after Initial Filing

Attorney Docket Number	P/61767
First Named Inventor	PIKE, ANDREW
COMPLETE IF KNOWN	
Application Number	09/914,936
Filing Date	SEPTEMBER 4, 2001
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled :

CHEMICAL SENSOR SYSTEMS

(Title of the Invention)

the specification of which

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) SEPTEMBER 4, 2001 as United States Application Number or PCT International

Application Number 09/914,936 and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code §119 (a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365 (a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	Certified Copy Attached? NO
9905051.0	United Kingdom	03.05.99	☐	☐	☒
PCT/GB00/00809	International	March 6, 2000	☐	☐	☒
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority sheet attached hereto:

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
		☐ Additional provisional application numbers are listed on a supplemental priority sheet attached hereto.

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DECLARATION

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U.S. Parent Application Number	PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number *(if applicable)*

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority sheet attached hereto.

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

☐ Firm Name [ ] Customer Number or label [ ]
OR
☒ List attorney(s) and/or agent(s) name and registration number below:

Name	Registration Number	Name	Registration Number
David B. Kirschstein, Esq.	17,244		
Alan Israel, Esq.	27,564		
Martin W. Schiffmiller, Esq.	30,421		

☐ Additional attorney(s) and/or agent(s) named on a supplemental sheet attached hereto.

Please direct all correspondence to: ☐ Customer Number or label [ ] OR ☒ Fill in correspondence address below

Name	KIRSCHSTEIN, OTTINGER, ISRAEL & SCHIFFMILLER, P.C.
Address	489 Fifth Avenue
Address	
City	New York
State	New York
ZIP	10017-6105
Country	United States
Telephone	(212) 697-3750
Fax	(212) 949-1690

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name	Middle Initial	Family Name	Suffix e.g. Jr.
Andrew		PIKE	

Inventor's Signature: + A. C Pike Date: 14 SEPTEMBER 2001

Residence: City	State	Country	Citizenship
Writtle, Chelmsford GBx		United Kingdom	British

Post Office Address: 39 Hunts Drive, Writtle, Chelmsford, ESsex, CM1 3HQ, (GB) UK

Post Office Address:

City	State	Zip	Country	Applicant Authority
Writtle, Chelmsford		CM1 3HQ	United Kingdom	

☐ Additional inventors are being named on supplemental sheet(s) attached hereto